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硕 士 学 位 论 文

同安湾下潭尾人工红树林湿地大型底栖动物群落恢复研究

Study on restoration of benthic macrofaunal community in Xiatanwei artificial mangrove wetlands, Tong'an Bay

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摘要

红树林生态系统处于海洋与陆地的动态交界面，是我国三大海岸带生态系统之一。底栖动物(包括大型、小型和微型底栖动物)是红树林生态系统的重要组成部分，同时也是该生态系统内物质循环、能量流动中积极的消费者和转移者。关于同安湾潮间带、潮下带和红树林湿地大型底栖动物群落生态的研究已有报道，但关于同安湾人工红树林湿地大型底栖动物群落恢复、演替和功能群方面的研究稀少，且关于红树林群落边缘大型底栖动物的群落效应的研究未见报道。

本研究选取同安湾下潭尾人工红树林湿地作为研究区域，比较了不同树龄红树林湿地大型底栖动物群落的时空变化、功能群组成、生物指数和边缘效应，分析了大型底栖动物群落参数与人工红树林湿地环境变量之间的关系，对比了生物指数、丰度生物量比较法评价人工红树林湿地生态环境现状的结果。研究结果可为红树林生态系统的恢复和管理、大型底栖动物资源的开发利用提供科学依据。主要研究成果如下：

1. 2014 年 4 月至 2015 年 1 月在同安湾下潭尾人工红树林湿地共获得大型底栖动物 93 种，其中定性采集到 40 种，定量采集到 65 种。定量和定性采集获得的共有种 12 种，仅占定量采集物种数的 18.46%、定性采集物种数的 30.00%。定量采集的大型底栖动物物种数以多毛类和甲壳类居多，均有 24 种；定性采集的大型底栖动物物种数以甲壳类为主，有 26 种。

2. 同安湾下潭尾人工红树林湿地大型底栖动物的年平均栖息密度为 695.4 ind.·m^{-2}。从树龄分布看，2 a 树龄红树林区大型底栖动物栖息密度最高，其次分别是光滩、1 a 林、9 a 林；从季节分布看，春季最高，其次分别是冬季、夏季和秋季。年平均生物量为 24.07 g·m^{-2}。从树龄上看，光滩大型底栖动物年平均生物量最高，其次分别是 2 a 林、9 a 林、1 a 林；从季节分布看，春季最高，其次分别是秋季、夏季和冬季。

3. 同安湾下潭尾人工红树林湿地定量采集的大型底栖动物功能群以杂食者为主要类型，达到 21 种；浮游生物食者物种数最少，只有 6 种。生境差异是影响该区域大型底栖动物功能群结构的主要因素。

4. 根据大型底栖动物群落评价人工红树林区边缘效应的强弱，发现林缘大

型底栖动物的物种数、栖息密度、物种丰富度和次级生产力均高于林内，证明边缘对该林区的大型底栖动物群落产生了正效应。

5. 运用生物多样性指数法、大型底栖动物污染指数 MPI 法、AMBI(海洋生物指数)和 M-AMBI(多变量海洋生物指数)指数法以及丰度-生物量比较（ABC）曲线法对同安湾下潭尾人工红树林湿地大型底栖动物群落进行环境健康评价，结果显示 2 a 红树林区处于轻度扰动状态，其他 3 种树龄红树林区处于无扰动和轻度扰动状态；同时 ABC 曲线法对 1 a 红树林区、2 a 红树林区以及 9 a 红树林区的评价结果与其他 3 类评价方法存在偏差，这可能与 ABC 曲线法在应用时存在局限性有关。

6. 分析同安湾下潭尾人工红树林湿地大型底栖动物群落与环境变量之间的关系，发现大型底栖动物群落的季节变化与海水盐度之间存在显著或极显著负相关关系，同时沉积物底质差异影响大型底栖动物物种数、栖息密度和生物量在不同龄红树林区的分布。

关键词：大型底栖动物；人工红树林湿地；群落恢复；同安湾

Abstract

Mangrove system is one of China's three major coastal ecosystems, usually situating in the dynamic interface between the marine and terrestrial ecosystems. Macrofauna is an important component of mangrove ecosystem, as well as a positive consumer and metastasis group in the material cycle and energy flow process. There are many researches about benthic macrofaunal community in the intertidal zones, subtidal zones and mangrove wetlands in Tong'an Bay, but researches on community restoration, succession and functional groups of benthic macrofauna in artificial mangrove wetlands in Tong'an Bay are relatively scarce.

This study selecting the artificial mangrove wetlands in Tong'an Bay as the study area, comparing the temporal and spatial variation of macrofaunal community among mudflat, 1-year mangrove forest, 2-year mangrove forest and 9-year mangrove forest. The relationship between environment variable and the macrofaunal community in different biotopes was analyzed. Simultaneously, this study comparing the biological indices and functional group composition of macrofaunal community in the artificial mangrove of different age, then contrasting the results of different evaluation methods. It was the first time to use the benthic macrofaunal community to explore the strength of edge effect in artificial mangrove forest. The results from the present study can provide a scientific basis for mangrove restoration and management, as well as the exploitation and utilization of macrofauna resources. The main results are as follows:

1. Ninety-three species of benthic macrofauna were obtained in the artificial mangrove wetlands of Tong'an Bay, including 40 species were obtained from the qualitative collection and 65 species were obtained from the quantitative collection. Collection of qualitative and quantitative shared a total of 12 common species, accounting for 18.46 percent of the species number of quantitative collection, and 30 percent of the species number of qualitative collection. Polychaetes and crustaceans had a majority in the quantitative collection of benthic macrofauna, both of them including 24 species. Crustaceans that amounted to 26 species was the dominant

group in qualitative sampling.

2. The annual average density of benthic macrofauna in the study area was 695.4 ind.·m^{-2}, in which the 2-year mangrove forest had the highest density, followed by mudflat, 1-year mangrove forest and 9-year mangrove forest. Among the seasonal distribution , spring had the highest density, followed by winter, summer and autumn. The annual average biomass of benthic macrofauna was 24.07 g·m^{-2}, the mudflat habitat shared the highest biomass, in which mudflat had the highest biomass, followed by 2-year mangrove forest, 9-year mangrove forest and 1-year mangrove forest. Among the seasonal distribution, the highest biomass appeared in spring, followed by autumn, summer and winter.

3. Omnivores group was the main benthic macrofaunal functional group in Tong'an Bay artificial mangrove wetlands, and planktonphagous group had the least number of species, only 6 species. Habitat diversity was a major factor that impacted the benthic macrofaunal functional group structure.

4. The edge effect of mangrove area was first discussed according to benthic macrofaunal community. It was found that species number, density, species richness and secondary productivity of benthic macrofauna in the forest edge were higher than in the forest interior. This result proved that the edge of mangrove forest had a positive effect to benthic macrofaunal community.

5. Biological diversity index, Macrofaunal Pollution Index (MPI), AZTI'S Marine Biotic Index (AMBI), Multivariate AZTI'S Marine Biotic Index (M-AMBI), and Abundance Biomass Comparison curve (ABC method) were applied to evaluate the environmental health of benthic macrofaunal community in Xiatanwei artificial mangrove wetlands, Tong'an Bay. The results showed that 2-year mangrove forest was slightly disturbed, while the other three biotopes were in undisturbed or mildly disturbed state. Meanwhile the evaluation result of ABC curve in the study area showed a deviation with other methods, which may be related to the limitation of ABC curve.

6. The relationship between benthic macrofaunal community in the artificial mangrove wetlands and environment variables was analyzed, it showed that there was

significant and extremely significant negative correlation between the seasonal variation of benthic macrofaunal community and seawater salinity, while the deposit sediment condition affect the species number, density, biomass of benthic macrofauna in different mangrove areas.

Key Words: Benthic macrofauna, Artificial mangrove wetlands, Community restoration, Tong'an Bay